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Takashi Udagawa

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7590

11/30/2004

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EXAMINER

BROCK II, PAUL E

ART UNIT

PAPER NUMBER

2815

DATE MAILED: 11/30/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

Application No.

09/881,782

Applicant(s)

UDAGAWA, TAKASHI

Examiner

Paul E Brock II

Art Unit

2815

*Paul*

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

## Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☒ Responsive to communication(s) filed on 18 October 2004.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 1-20 is/are pending in the application.
- 4a) Of the above claim(s) 8-10 and 18 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-7, 11-17, 19 and 20 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 21 March 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

## Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some \* c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

## Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date \_\_\_\_\_.
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_.

## **DETAILED ACTION**

### ***Information Disclosure Statement***

1. The listing of references in the specification is not a proper information disclosure statement. 37 CFR 1.98(b) requires a list of all patents, publications, or other information submitted for consideration by the Office, and MPEP § 609 A(1) states, "the list may not be incorporated into the specification but must be submitted in a separate paper." Therefore, unless the references have been cited by the examiner on form PTO-892, they have not been considered.

For example, at least on pages 6 – 11 of the originally filed specification, there are a plurality references listed, however, they are not listed on any information disclosure statements which have been filed.

### ***Claim Rejections - 35 USC § 103***

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

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3. Claims 1 – 3 and 6, 7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ming-Jiunn et al. (USPAT 6078064, Ming-Jiunn) in view of Ohba et al. (USPAT 5076860, Ohba), Lee et al. (USPAT 5789768, Lee), and Okazaki et al (USPAT 5977566, Okazaki).

With regard to claim 1, Ming-Jiunn discloses in figure 7 a group-III nitride semiconductor light-emitting diode comprising at least a first conduction-type single crystal substrate (52) provided with a first conduction-type back-surface ohmic electrode (19) on a back surface thereof, a buffer layer (16) on a front surface of the single crystal substrate, a gallium nitride (GaN)-based group-III nitride crystal layer (13/14) having a light-emitting part of hetero-junction structure on the buffer layer, and a window layer (11b) comprising an electrically conducting transparent oxide crystal layer on the group-III nitride crystal layer, wherein at least a second conduction-type surface ohmic electrode (42) conductive with the window layer is between the surface of the group-III nitride crystal layer and the window layer and comes into contact with the surface of the group-III nitride crystal layer and a whole pad electrode for wire bonding is on the center of the upper surface of the window layer. Ming-Jiunn does not teach that the buffer layer comprises a boron phosphide (BP)- based material. Ohba teaches in figure 13 a buffer layer (62) comprising a boron phosphide (BP)-based material on a front surface of a single crystal substrate (61). It would have been obvious to one of ordinary skill in the art at the time of the present invention to use the boron phosphide buffer layer of Ohba in the device of Ming-Jiunn in order to form an indirect transition buffer layer as stated by Ohba in column 11, lines 30 – 35. Ming-Jiunn and Ohba do not teach that the second conduction –type surface ohmic electrode is disposed on a region other than the projective region and that the window layer covers and is in contact with the surface of the group-III crystal layer on the entire

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projective region of the pad electrode. Lee teaches in figure 5a, and column 4, lines 59 – 20 a second conduction-type surface ohmic electrode (58) is disposed on the surface of a region other than a projective region of the pad electrode on a group-III crystal layer, and a window layer covers and is in contact with the surface of the group-III crystal layer on the entire projective region of the pad electrode. It would have been obvious to one of ordinary skill in the art at the time of the present invention to use the electrode at a position other than the projective region and the window layer in contact with the crystal layer on the entire projective region in the group III nitride crystal device of Ming-Jiunn and Ohba in order to form a schottky barrier having good current blocking capability and therefore contribute to higher power output during normal operating conditions as stated by Lee in column 4, line 59 – column 5, line 20. Ming-Jiunn, Ohba, and Lee do not teach that the second conduction type-surface ohmic electrode is comprised of a plurality of electrodes. Okazaki teaches in figure 4, figure 5e, column 6, lines 6 – 9, and column 7, lines 57 – 58 a second conduction-type surface ohmic electrode (45) composed of a plurality of electrodes which are disposed on a surface of a region other than the projective region of the pad electrode on a group III crystal layer. It would have been obvious to one of ordinary skill in the art at the time of the present invention to use the second conduction type surface ohmic electrode of Okazaki on the surface of the group III nitride crystal layer in the method of Ming-Jiunn, Ohba and Lee in order to scatter the current and therefore emit more light than the prior art as stated by Okazaki in column 6, lines 7 – 10 and 49 – 53.

With regard to claim 2, Okazaki teaches in figure 4, figure 5e, column 6, lines 6 – 9, and column 7, lines 57 – 58 wherein the second conduction-type surface ohmic electrodes are disposed in a periphery of the pad electrode.

With regard to claim 3, Okazaki teaches in figure 4, figure 5e, column 6, lines 6 – 9, and column 7, lines 57 – 58 wherein the second conduction-type surface ohmic electrodes are disposed at a bilaterally symmetric position with respect to the center of the pad electrode.

With regard to claim 6, Okazaki teaches in figure 4, figure 5e, column 6, lines 6 – 9, and column 7, lines 57 – 58 wherein the second conduction-type surface ohmic electrodes are disposed in an open light-emitting region other than a projective region of the pad electrode on the surface of the group-III crystal layer. It would have been further obvious in the method of Ming-Jiunn, Ohba, Lee, and Okazaki wherein the second conduction-type surface ohmic electrodes are disposed in an open light-emitting region other than a projective region of the pad electrode on the surface of the group-III nitride crystal layer.

With regard to claim 7, Okazaki teaches in figure 4, figure 5e, column 6, lines 6 – 9, and column 7, lines 57 – 58 wherein the sum of areas of second conduction-type surface ohmic electrodes is from 5 to 30% of a total area of the open light-emitting region.

4. Claims 4 and 5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ming-Jiunn, Ohba, Lee, and Okazaki as applied to claim 1 above, and further in view of Bastek (USPAT 4232440).

It is not clear if Ming-Jiunn, Ohba, Lee and Okazaki teach wherein the second conduction-type surface ohmic electrodes are disposed at isometric positions from the center of the pad electrode. Bastek teaches in figure 3 wherein a second conduction-type surface ohmic electrodes (16) are disposed at isometric positions from the center of a pad electrode (15). It would have been obvious to one of ordinary skill in the art at the time of the present invention to

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use the positioning of Bastek in the device of Ming-Jiunn, Ohba, Lee, and Okazaki in order to make contact to a light emitting portion of a light emitting device with a high degree of reliability and with minimum interference with light emission.

5. Claims 11 – 13, 16, 17, 19, and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ming-Jiunn in view of Lee and Okazaki.

With regard to claim 11, Ming-Jiunn discloses in figure 7 an electrode for group-III nitride semiconductor light-emitting diodes for a group-III semiconductor light-emitting diode comprising at least a gallium nitride (GaN)-based group-III nitride crystal layer (13/14) having a light-emitting part of hetero-junction structure, and a window layer (11b) comprising an electrically conducting transparent oxide crystal layer provided on the group-III nitride crystal layer, wherein at least a surface ohmic electrode (42) conductive with the window layer is between the surface of the group-III nitride crystal layer and the window layer and comes into contact with the surface of the group-III nitride crystal layer and a whole pad electrode for wire bonding is disposed on the center of the upper surface of the window layer. Ming-Jiunn does not teach that the second conduction –type surface ohmic electrode is disposed on a region other than the projective region and that the window layer covers and is in contact with the surface of the group-III crystal layer on the entire projective region of the pad electrode. Lee teaches in figure 5a, and column 4, lines 59 – 20 a second conduction-type surface ohmic electrode (58) is disposed on the surface of a region other than a projective region of the pad electrode on a group-III crystal layer, and a window layer covers and is in contact with the surface of the group-III crystal layer on the entire projective region of the pad electrode. It would have been obvious to

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one of ordinary skill in the art at the time of the present invention to use the electrode at a position other than the projective region and the window layer in contact with the crystal layer on the entire projective region in the group III nitride crystal device of Ming-Jiunn in order to form a schottky barrier having good current blocking capability and therefore contribute to higher power output during normal operating conditions as stated by Lee in column 4, line 59 – column 5, line 20. Ming-Jiunn and Lee do not teach that the second conduction type-surface ohmic electrode is comprised of a plurality of electrodes. Okazaki teaches in figure 4, figure 5e, column 6, lines 6 – 9, and column 7, lines 57 – 58 a second conduction-type surface ohmic electrode (45) composed of a plurality of electrodes which are disposed on a surface of a region other than the projective region of the pad electrode on a group III crystal layer. It would have been obvious to one of ordinary skill in the art at the time of the present invention to use the second conduction type surface ohmic electrode of Okazaki on the surface of the group III nitride crystal layer in the method of Ming-Jiunn and Lee in order to scatter the current and therefore emit more light than the prior art as stated by Okazaki in column 6, lines 7 – 10 and 49 – 53.

With regard to claim 12, Okazaki teaches in figure 4, figure 5e, column 6, lines 6 – 9, and column 7, lines 57 – 58 wherein the surface ohmic electrodes are disposed in a periphery of the pad electrode.

With regard to claim 13, Okazaki teaches in figure 4, figure 5e, column 6, lines 6 – 9, and column 7, lines 57 – 58 wherein the surface ohmic electrodes are disposed at a bilaterally symmetric position with respect to the center of the pad electrode.



With regard to claim 16, Okazaki teaches in figure 4, figure 5e, column 6, lines 6 – 9, and column 7, lines 57 – 58 wherein the surface ohmic electrodes are disposed in an open light-emitting region other than a projective region of the pad electrode on the surface of the group-III crystal layer. It would have been further obvious in the method of Ming-Jiunn, Ohba, Lee, and Okazaki wherein the surface ohmic electrodes are disposed in an open light-emitting region other than a projective region of the pad electrode on the surface of the group-III nitride crystal layer.

With regard to claim 17, Okazaki teaches in figure 4, figure 5e, column 6, lines 6 – 9, and column 7, lines 57 – 58 wherein the sum of areas of surface ohmic electrodes is from 5 to 30% of a total area of the open light-emitting region.

With regard to claim 19, Ming-Jiunn discloses in figure 7 forming a surface ohmic electrode in contact with a surface of a gallium nitride (GaN)-based group-III nitride crystal layer having a light-emitting part of hetero-junction structure. Ming-Jiunn discloses in figure 7 then covering the surface of the group-III nitride crystal layer and the surface ohmic electrode to form a window layer comprising an electrically conducting transparent oxide crystal layer conductive with the surface ohmic electrode. Ming-Jiunn discloses in figure 7 then forming a whole pad electrode for wire bonding on a center of the upper surface of the window layer conductive with the window layer. Ming-Jiunn does not teach that the second conduction-type surface ohmic electrode is disposed on a region other than the projective region and that the window layer covers and is in contact with the surface of the group-III crystal layer on the entire projective region of the pad electrode. Lee teaches in figure 5a, and column 4, lines 59 – 20 a second conduction-type surface ohmic electrode (58) is disposed on the surface of a region other than a projective region of the pad electrode on a group-III crystal layer, and a window layer covers and

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is in contact with the surface of the group-III crystal layer on the entire projective region of the pad electrode. It would have been obvious to one of ordinary skill in the art at the time of the present invention to use the electrode at a position other than the projective region and the window layer in contact with the crystal layer on the entire projective region in the group III nitride crystal device of Ming-Jiunn in order to form a schottky barrier having good current blocking capability and therefore contribute to higher power output during normal operating conditions as stated by Lee in column 4, line 59 – column 5, line 20. Ming-Jiunn and Lee do not teach that the second conduction type-surface ohmic electrode is comprised of a plurality of electrodes. Okazaki teaches in figure 4, figure 5e, column 6, lines 6 – 9, and column 7, lines 57 – 58 a second conduction-type surface ohmic electrode (45) composed of a plurality of electrodes which are disposed on a surface of a region other than the projective region of the pad electrode on a group III crystal layer. It would have been obvious to one of ordinary skill in the art at the time of the present invention to use the second conduction type surface ohmic electrode of Okazaki on the surface of the group III nitride crystal layer in the method of Ming-Jiunn and Lee in order to scatter the current and therefore emit more light than the prior art as stated by Okazaki in column 6, lines 7 – 10 and 49 – 53.

With regard to claim 20, Ming-Jiunn discloses in figure 7 wherein the pad electrode is formed on the group-III nitride crystal layer through a window layer comprising an electrically conductive transparent oxide crystal layer so that the electrically conducting transparent oxide crystal layer is not present on the surface of the pad electrode used for wire bonding.

6. Claims 14 and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ming-Jiunn, Lee, and Okazaki as applied to claim 11 above, and further in view of Bastek (USPAT 4232440).

It is not clear if Ming-Jiunn, Lee, and Okazaki teach wherein the surface ohmic electrodes are disposed at isometric positions from the center of the pad electrode. Bastek teaches in figure 3 wherein surface ohmic electrodes (16) are disposed at isometric positions from the center of a pad electrode (15). It would have been obvious to one of ordinary skill in the art at the time of the present invention to use the positioning of Bastek in the device of Ming-Jiunn, Lee, and Okazaki in order to make contact to a light emitting portion of a light emitting device with a high degree of reliability and with minimum interference with light emission.

#### ***Response to Arguments***

7. Applicant's arguments filed October 18, 2004 have been fully considered but they are not persuasive.

8. With regard to applicant's argument that "Lee et al., as noted by the Examiner forms a Schottky barrier at the interface between the conductive transparent oxide layer 60 and the window layer 56 in order to block current underneath contact (pad) 62 (i.e., to mitigate against the current-spreading effect of window layer 56 over the entire surface of the LED)," it should be noted that an ohmic contact is formed at the interface between the conductive transparent oxide layer 60 and the window layer 56 (see column 4, lines 47 – 52 of Lee). Lee further describes in

column 5, lines 5 – 20 that during normal lead operating conditions a Schottky barrier is produced in the regions where window layer 56 and transparent conductive layer 62 are in direct contact. Ohmic contact persists in the regions where contact layer 58 is between window layer 56 and transparent conductive layer 62. This condition, during normal operation, increases the power output of the device. Applicant never states that this increased power output is not desirable. It should be noted that the window layer of Lee is used for the equivalent purpose as the claimed group-III nitride crystal layer, and the applicant's claimed window layer is equivalent to Lee's conductive transparent oxide layer 60. Applicant's lack of discussing a Schottky barrier formation in the regions where the group-III nitride crystal layer is in direct contact with the claimed window layer does not preclude this Schottky barrier from occurring during normal operation of the light-emitting diode. Therefore, applicant's arguments are not persuasive and the rejection is proper.

9. With regard to applicant's arguments that "the interface of layers 306/305 in Fig. 3 of the present specification does not form a Schottky barrier," it should be noted that applicant's original specification does not provide support for this suggestion. Instead, applicant's originally filed specification seems to support the creation of a Schottky barrier in the interface of layers 306/305, but does not explicitly call it a Schottky barrier. Lee teaches in column 4, line 59 – column 5, line 20 that the Schottky barrier formed in the interface between layers 60 and 56 creates good current blocking while at the same time allowing the current to flow in the regions where contact layer 58 is between layers 56 and 60, i.e., the ohmic contact regions. This appears to be a similar phenomenon that the applicant describes on page 13, line 33 – page 14, line 25.

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In particular on page 14, lines 7 – 15 applicant describes “When the device operating current is allowed to flow only to the open light-emitting region 307b, which is opened to the outside and therefore, facilitated in displaying the emitted light to the outside, the current density of the device operating current which in turn flows to, for example, the light-emitting part 30 having a gallium indium nitride ( $\text{Ga}_Y\text{In}_{1-Y}\text{N}$ , where  $0 \leq Y \leq 1$ ) light-emitting layer 304, which is located below the open light-emitting region 307b, is increased, which is advantageous in obtaining a group – III nitride semiconductor LED having high-intensity light emission.” Since current only flows in the light emitting region 307b, and the difference between light emitting region 307b and the projection region 307a is the existence of ohmic contacts 308 in regions 307b, it can be concluded that the current is flowing through the ohmic contacts 308 and not in the regions where there is a direct interface between layers 306 and 305. While described differently, this is the same phenomenon that occurs with the Schottky barrier in Lee. Therefore, applicant’s arguments are not persuasive and the rejection is proper.

10. With regard to applicant’s argument that “layer 308 of the present invention homogeneously diffuses the current which flows to layer 305 (see page 14, lines 19 – 22),” it should be noted that this citation supports the above argument made in paragraph 9. The ability of the ohmic contact layer 308 to “homogeneously” diffuse current flowing between layers 308 and 305 is a direct reference to the fact that the current flow between these layers only occurs through the ohmic contact layer 308 in applicant’s invention. This is supported by the fact that there is no current flow in the regions where there is only a direct interface between layers 305

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and 306 (see arguments in paragraph 9, above). Therefore, applicant's arguments are not persuasive and the rejection is proper.

11. With regard to applicant's argument with respect to the reference of T. Margalith et al., if this reference is provided in an information disclosure statement in accordance with 37 CFR 1.98(b) the office will consider its teachings. Please see paragraph 1, above. As far as the examiner can ascertain from the limited reference made by the applicant in the arguments and specification, T. Margalith et al. is not concerned with light emitting diodes and the operation thereof. While ITO and GaN interfaces might form an ohmic contact, it is not clear from the limited knowledge of T. Margalith et al. supplied by the applicant that this is the case under normal operating conditions of a LED. Therefore, applicant's arguments are not persuasive and the rejection is proper.

12. With regard to applicant's arguments that "the window layer must cover and must be in contact with the surface of the group – III nitride crystal layer on the entire projected region of the pad electrode... is not met by any of the figures of Lee, where conductive transparent oxide layer 60 is not in contact with top cladding layer 544," it should be noted that the rejection does not rely on conductive transparent oxide layer 60 to be in contact with to cladding layer 544. Instead, the rejection clearly relies on the conductive transparent oxide layer 60 of Lee to be in contact with the group-III crystal window layer 56. It is not clear why applicant wants to use the cladding layer 544 of Lee as the group-III crystal layer of the claims when the rejection clearly

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points out that the group-III crystal window layer 56 is used to read on the claim recitation.

Therefore, applicant's arguments are not persuasive and the rejection is proper.

13. With regard to applicant's suggestion that "Applicant respectfully requests the Examiner to carefully study and reconsider this particular aspect of the rejection," it should be noted that this has been done. While examiner notes that the dopant types in the layers of Lee and the presently disclosed application are opposite, one of ordinary skill would recognize that similar results can be obtained with oppositely doped devices. It should be noted that the dopant types are not claimed, and therefore do not constitute a persuasive argument. Further, the fact that Lee names his layers differently than the applicant does, does not provide the layers with different functions than the claimed invention. Examiner finds that applicant's arguments are not persuasive and the rejection is proper.

14. In response to applicant's arguments against the references individually, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

### ***Conclusion***

15. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Paul E Brock II whose telephone number is (571) 272-1723. The examiner can normally be reached on 8:30 AM - 5:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tom Thomas can be reached on (571) 272-1664. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Paul E Brock II

A handwritten signature in black ink, appearing to read "Paul E Brock II", with a stylized, cursive script.